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Non-thermal parametric variations using the Si IV spectral line observed by IRIS

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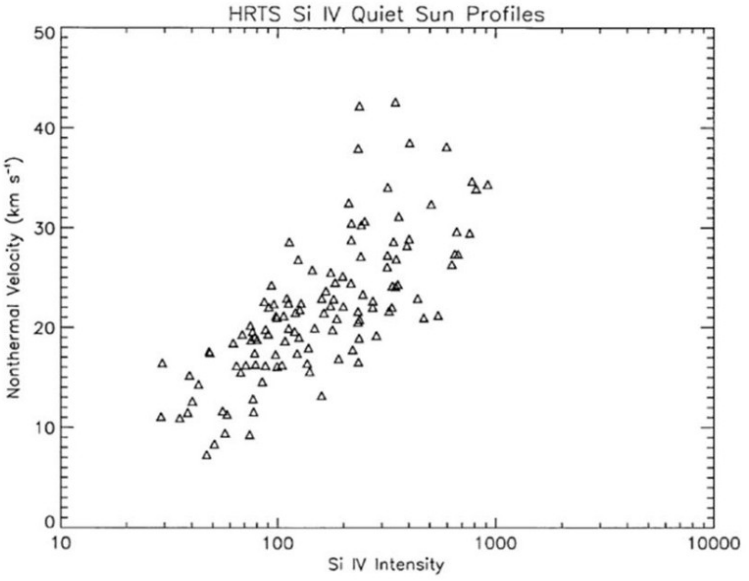
INTRODUCTION

Non-thermal widths are still not well understood. Measuring non-thermal widths provides constraints on the possible way that the TR might be heated.

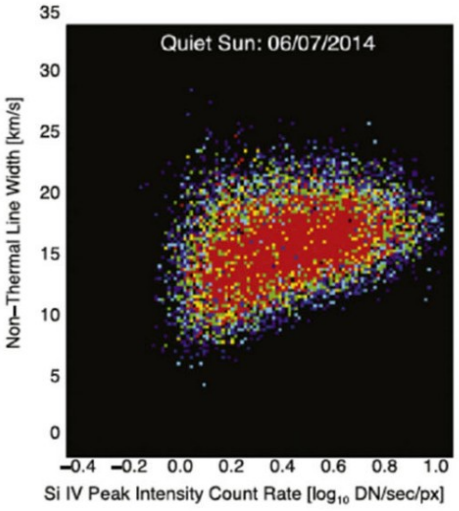
$$\sigma^2 = \frac{\lambda_0^2}{2c^2}\left(\frac{2kT_i}{M} + \xi^2\right) + \sigma_I^2$$

where ξ is the non-thermal velocity, i.e., the most probable velocity of the random bulk plasma motions, assuming they are Maxwellian.



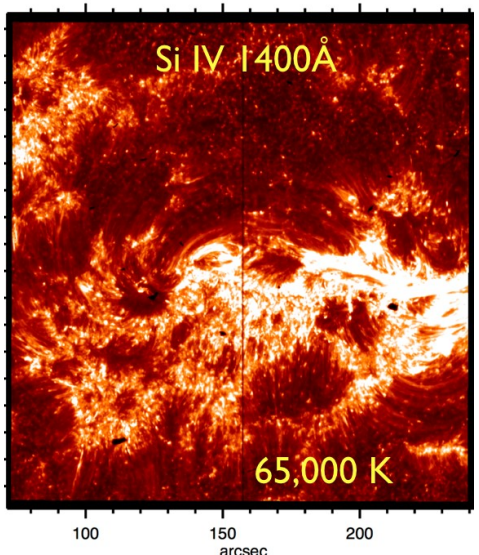
Del Zanna and Mason, LRSP (2018)

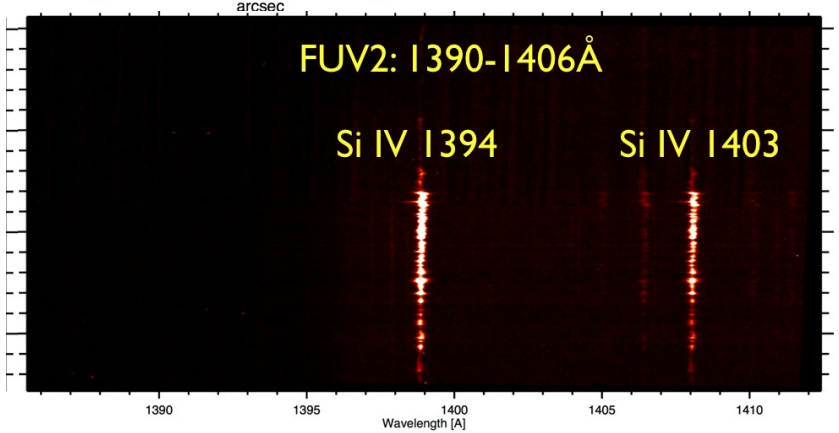
Left panel: The Si IV non-thermal velocities in the quiet Sun region observed with HRTS were found to be 22 km/s *(Dere and Mason, 1993)*.



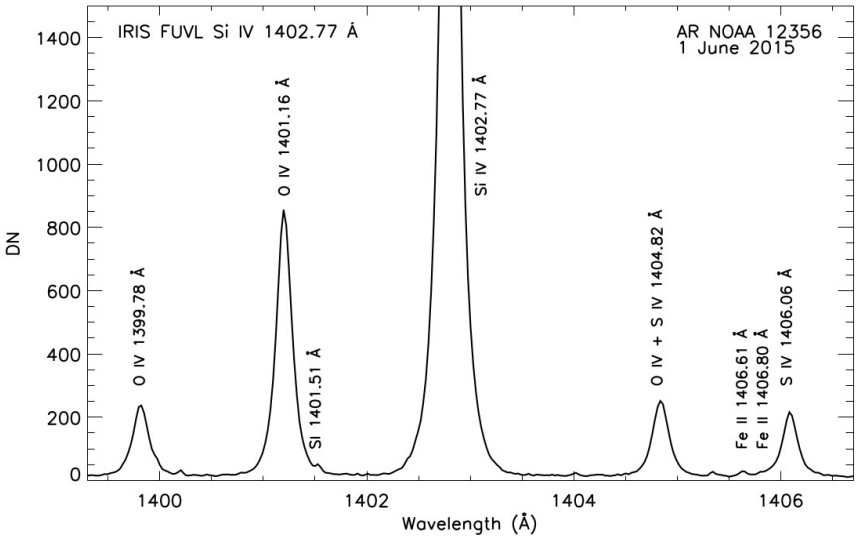
Right panel: *De Pontieu et al. (2015)* observed the variation of non-thermal velocities using the Si IV line from IRIS in different regions (QS, AR, CH) of the Sun and found it to be ~15 km/s.

Various lines observed by IRIS





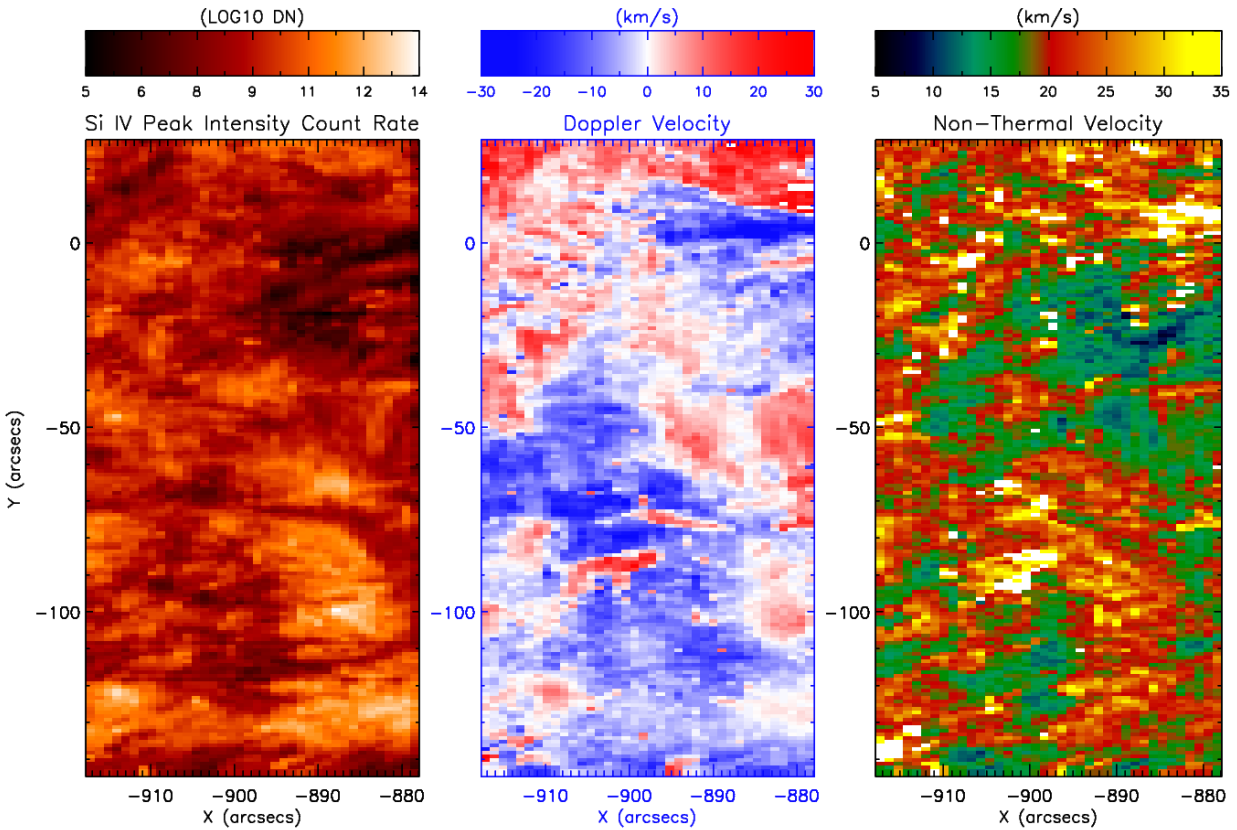
The IRIS spectrograph observed spectra in 1332-1358, 1389 – 1407, and 2783 – 2834 A spectral ranges.

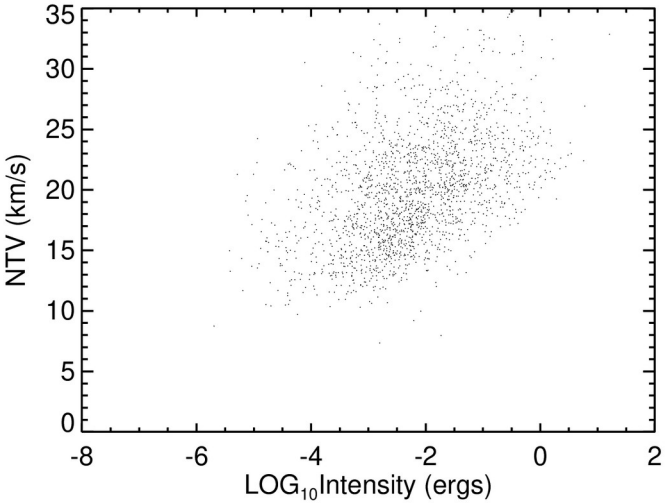


Polito et. al, A&A (2018)

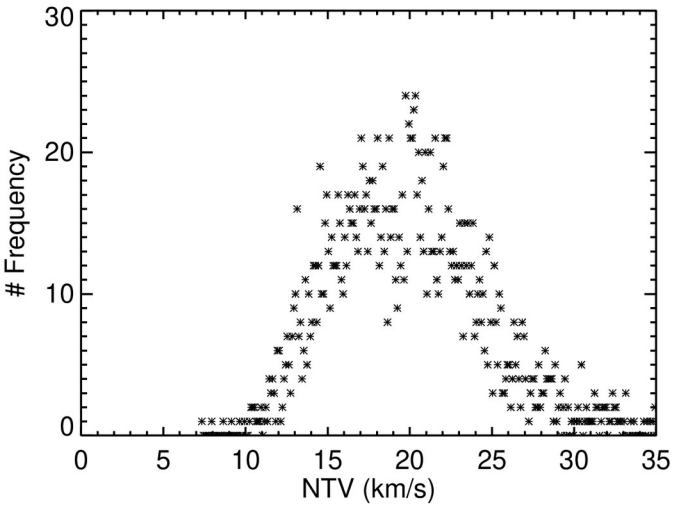
The Si IV is an optically thin line having a formation temperature of 80,000 K. **We study various observations of the Quiet Sun having high spatial, temporal, and spectral resolution to provide a better insight into the coronal heating mechanism.**

QS near the East Limb observed on 04th October 2013.
Exposure time: 30 s exposure time

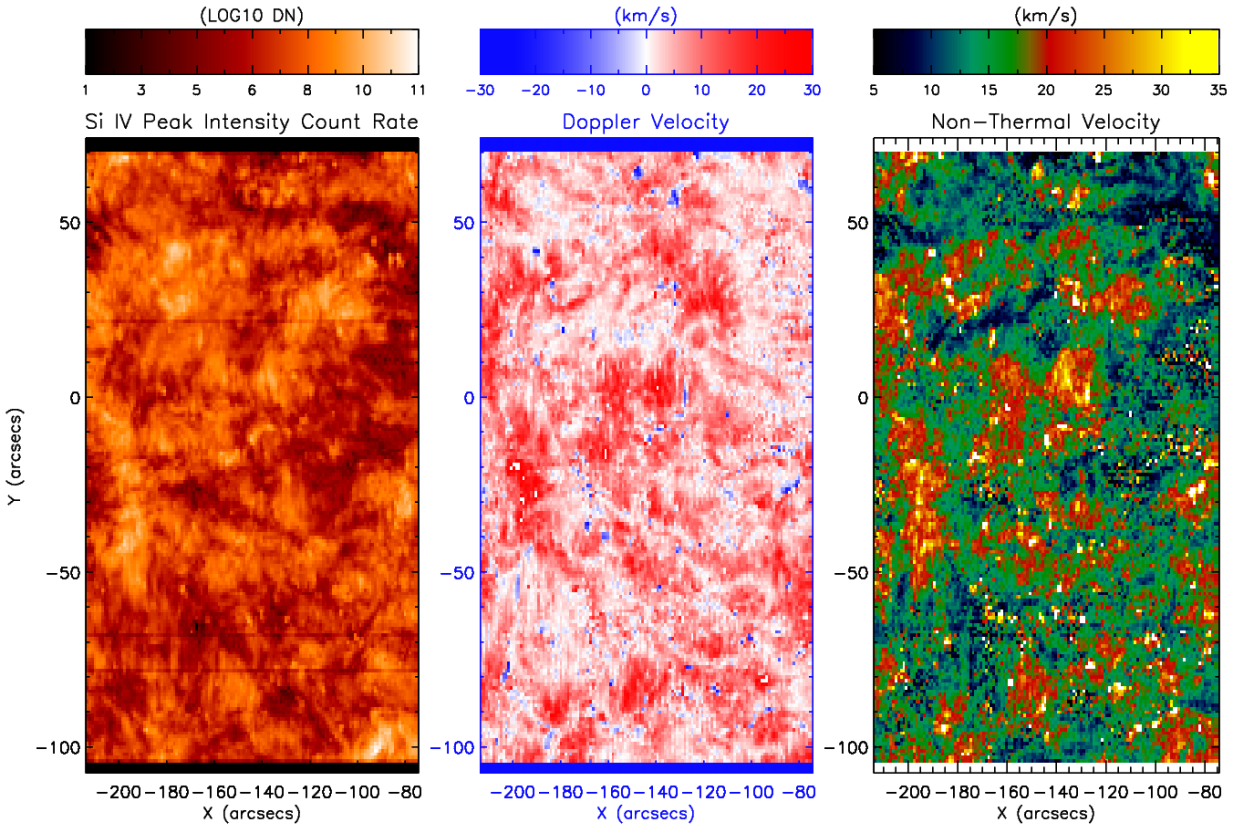


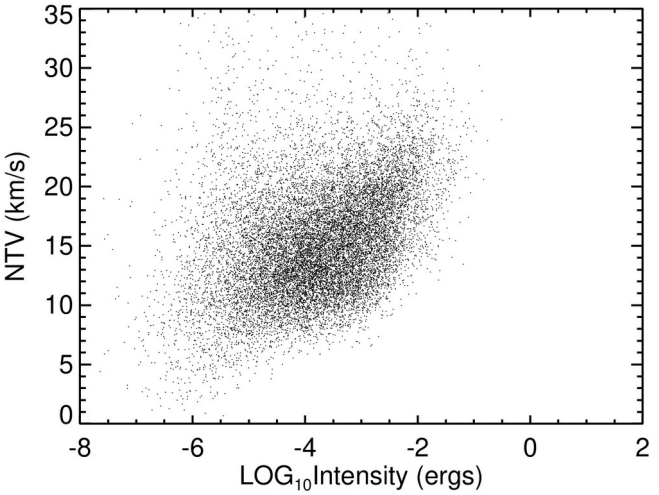


Distribution of NTW and its correlation with the Intensity

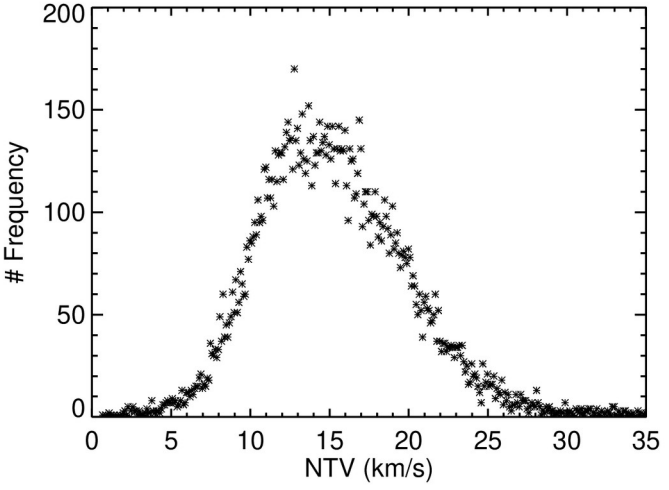


QS at the Disc Centre observed on 25th February 2014.
Exposure time: 30 s exposure time

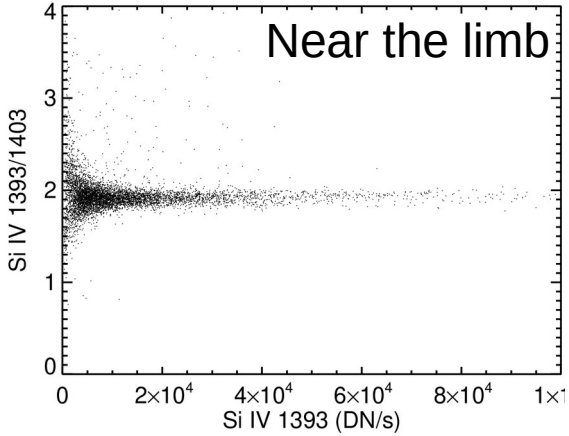


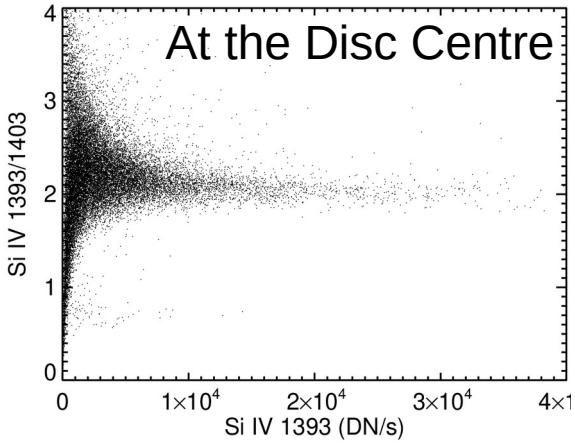


Distribution of NTW and its correlation with the Intensity



Statistical Studies of various QS Observations





Obs Date & Start Time	Raster	Exposure time (s)	Location (R.)	Peak of NTW (km/s)
20/09/2013 (14:31)	Very Large Dense	4	North Limb (0.92)	19.4
04/10/2013 (15:01)	Very Large Dense	30	East limb (0.81)	19.3
26/09/2013 (16:50_r0)	Very Large Sparse	8	QS Disc (0.47)	14.9
26/09/2013 (16:50_r1)	Very Large Sparse	8	QS Disc (0.47)	14.7
22/10/2013 (11:30)	Very Large Dense	30	QS Disc (0.34)	16.1
27/10/2013 (01:22)	Very Large Coarse	4	QS Disc (0.009)	16.5
25/02/2014 (18:59)	Very Large Dense	8	QS Disc (0.13)	15.3
25/02/2014 (20:50)	Very Large Dense	30	QS Disc (0.11)	14.9

Centre-to-limb variation is being observed.

RESULTS

- From the observations we have studied, we present evidence of the non-thermal widths of the Si IV line in the Quiet-Sun varying from centre to limb. The values vary from 20 km s^{-1} near the limb to 15 km s^{-1} near the disc centre.
- This variation is independent of the temporal exposure.
- The values of non-thermal widths are lower than previously observed using different instruments and longer exposure times.
- We conclude that these Doppler motions are transverse to the radial. The possibility of swaying/torsional motions leading to such variations are validated using these IRIS observations.
- IRIS has very good spatial, temporal, and spectral resolution to enable such measurements. This study will help us in interpreting upcoming new observations from the Solar Orbiter SPICE spectrometer.

THANKS!!!